Research Article

Estimation of Dental Age by Demirjian and Willems Method in a Tertiary Care Hospital of Nepal

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ABSTRACT

Introduction: Dental age estimation using orthopantomogram is very useful in pediatric dentistry, orthodontics in clinical diagnosis and treatment planning and also has forensic application. Demirjian method is widely used for age estimation and Willems method has been suggested to be accurate than Demirjian in various populations. To estimate the dental age of children in a specific population of Nepal by Demirjian and Willems method, compare them with the chronological age and assess their applicability.

Materials and Method: Digital orthopantomograms of 5 to 14 years of children were used to estimate the dental age by Demirjian's 7- teeth method and Willems method. Descriptive statistics was used and mean with standard deviation was calculated for gender and age of the samples. Paired t-test was used for comparison of chronological age with dental age. $P < 0.05$ was considered as statistically significant.Pearson correlation was used to assess the correlation between chronological and dental age in both the genders.

Result: By Demirjian method, there was an underestimation of 0.276 years in males and 0.194 in females and by Willems method, 0.652 in males and 0.847 in females which were statistically significant. There was an underestimation of dental age in all the age groups except in the age group of 5,7 and 14 for Demirjian age which was statistically nonsignificant. Pearson correlation demonstrated strong positive correlation between chronological age and dental age.

Conclusion: The underestimation of dental age was more by Willems method as compared to Demirjian method. There was a strong positive relationship between chronological age and dental age in both the genders. Demirjian's 7- teeth method was more applicable as compared to Willems method when tested in selected Nepalese children population.

KEYWORDS: Age estimation, Dental age, Demirjian method, Nepalese children, Willems method

INTRODUCTION

Dental age estimation has significance in clinical practice in pediatric dentistry, orthodontics, research in biological growth and development as well as in forensic odontology.

Estimation of dental age in children can simply be done on the basis of time of teeth emergence but tooth calcification has been found to be a definitive measure of dental maturity as it is not influenced by local factors such as the loss of primary teeth, crowding, malnutrition, caries, ankylosis.[1-3] There are various methods for estimation of dental age in children based on permanent tooth formation.[1, 3, 4 -7]

The most widely used method is Demirjian method. This method was first done in French Canadian population.[1] Several researches using this method in different population has either overestimated[8-11] or underestimated dental development.[12, 13]

Demirjian method was modified by Willems and colleagues and when applied in Belgian Caucasian children, the dental age estimation was found to be more accurate than the original method.[3]

Meta-analysis of published studies on dental age has found Demirjian method being significantly overestimating the chronological age as compared to Willems method[14] advocating the later to be more accurate.[14,15] However, population specific growth standard is required as dental development of children varies among different population.[3, 16-18]

So, this research was conducted to estimate the dental age of children in a specific population of Nepal by Demirjian and Willems method, compare them with the chronological age and assess their applicability.

MATERIALS AND METHOD

A prospective cross- sectional study was conducted in department of Pediatric and Preventive Dentistry, Kathmandu University School of Medical Sciences from December 2020 to April 2021. Ethical approval for the research was obtained prior from Institutional review committee, Kathmandu University School of Medical Sciences.

Sample size was calculated using the formula $(Z\alpha+Z\beta)^2 \sigma^2 / d^2$ keeping 95% confidence interval and 80% power. $\sigma=1.55$.[19]

Mean difference was kept as 0.49. So, n ≈78.4620 for females. Thus, the estimated total sample N for both the genders was calculated to be 158.

One hundred and ninety-one children of age 5-14 years who visited Pediatric and Preventive Dentistry department of Dhulikhel hospital during the study period for dental treatment and requiring orthopantomogram (OPG) were included in the research. The children were selected on certain criteria as:

Inclusion criteria:

1. Healthy children of age 5 years to 14 years
2. Good quality digital OPG
3. Parents giving informed consent

Exclusion criteria:

1. Children with growth related disorder, any congenital or genetic abnormalities, any systemic disease that affects eruption of teeth
2. Presence of any gross pathology
3. Multiple missing teeth
4. Poor quality digital OPG
5. Radiographs of children with unknown age

The details like date of birth of each patient, gender and date of radiograph taken were recorded by a receptionist of Pediatric and Preventive Dentistry department. Chronological age was calculated in decimal by subtracting the date of radiograph taken from the date of birth.

Dental age was assessed by two methods; Demirjian's 7-teeth and Willems by single investigator (principal investigator). For Demirjian method, seven mandibular left permanent teeth were assessed and staged according to the development from digital OPGs. Maturity score was given for each tooth and based on this dental age was estimated.[1] For Willems method, seven left mandibular teeth were assessed, staged and dental age was estimated according to the chart.[3] Investigator was blinded for chronological age and sex of the patient. The data was entered and analyzed using version 25.0 of the Statistical Package for Social Sciences (IBM Corporation, Armonk, New York, USA).

Descriptive statistics was used and mean with standard deviation was calculated for gender and age of the samples. Paired t-test was used for comparison of chronological age and dental age. Statistical significance level was set at 0.05. Pearson correlation was used to assess the correlation between chronological and dental age in both the genders with statistical significance level set at 0.01.

RESULT

The study population consisted of 191 children with 108(56.5%) males and 83(43.5%) females. For both the genders, the chronological age (CA) was ahead of dental age and the mean difference between them were statistically significant (p=0.000) (table 1, 2). For Demirjian age (DA), there was an underestimation of 0.276 years in males and 0.194 in females (table 2) and for Willems age (WA), there was an underestimation of 0.652 in males and 0.847 in females (table 3) which were statistically significant. The delay was seen more in WA as compared to DA. DA was ahead of WA by 0.375 in males and 0.652 in females and was statistically significant (table 3).

When the mean difference between chronological age and dental age (DA, WA) was compared according to the different ages, there was underestimation in all the age groups (table 4, 5). However, in the age group of 5,7 and 14 for DA it was statistically nonsignificant (table 4).

With Pearson's correlation, a strong positive association between CA and DA was found for both the genders (0.991 for males and 0.989 for females). Similar association was found between CA and WA (0.988 for males, 0.980 for females) and between DA and WA as well (0.988 for males and 0.991 for females). All the associations were statistically significant ($p < 0.01$).

Table 1. Comparison of mean chronological age (CA) and Demirjian age (DA) among study participants

Gender	N	CA		DA		Mean age difference	Confidence interval	t	p
		Mean	S.D.	Mean	S.D.				
Male	108	9.44	2.61	9.16	2.59	.276	(.211- .342)	8.39	.000*
Female	83	10.09	2.80	9.89	2.80	.194	(.101- .287)	4.17	.000*
Total	191	9.72	2.71	9.48	2.70	.240	(.186 - .295)	8.73	.000*

*Statistically significant at p <0.05

Table 2. Comparison of mean chronological age (CA) and Willems age (WA) among study participants

Gender	N	CA		WA		Mean age difference	Confidence interval	t	p
		Mean	S.D.	Mean	S.D.				
Male	108	9.44	2.61	8.79	2.56	.652	(.573- .730)	16.42	.000*
Female	83	10.09	2.80	9.24	2.72	.847	(.725- .969)	13.81	.000*
Total	191	9.72	2.71	8.98	2.64	.736	(.667 - .806)	20.78	.000*

*Statistically significant at p <0.05

Table 3. Comparison of mean Demirjian age (DA) and Willems age (WA) among study participants

Gender	N	Demirjian Age		William Age		Mean age difference	Confidence interval	t	p
		Mean	S.D.	Mean	S.D.				
Male	108	9.16	2.59	8.79	2.56	.375	(.300- .451)	9.85	.000*
Female	83	9.89	2.80	9.24	2.72	.652	(.571- .733)	16.05	.000*
Total	191	9.48	2.70	8.98	2.64	.496	(.437 - .554)	16.80	.000*

*Statistically significant at p <0.05

Table 4. Mean difference between chronological age (CA) and Demirjian age (DA) among different age groups

Age	N	CA		DA		Mean age difference	Confidence interval	t	p
		Mean	S.D.	Mean	S.D.				
5-5.9	19	5.45	.23	5.31	.56	.148	-.052 - .350	1.55	.137
6-6.9	18	6.54	.25	6.39	.30	.147	.016 - .278	2.37	.029*
7-7.9	22	7.44	.25	7.30	.49	.143	-.014 - .300	1.88	.073
8-8.9	25	8.58	.27	8.37	.54	.212	.022 - .040	2.30	.030*
9-9.9	19	9.45	.23	9.15	.37	.301	.107 - .495	3.26	.004*
10-10.9	18	10.53	.27	10.08	.49	.452	.304 - .600	6.44	.000*
11-11.9	25	11.56	.29	11.21	.46	.348	.209 - .488	5.17	.000*
12-12.9	18	12.41	.26	12.17	.50	.237	.044 - .431	2.59	.019*
13-13.9	16	13.53	.29	13.34	.48	.189	.035 - .343	2.61	.019*
14-14.9	11	14.49	.27	14.30	.66	.196	-.157 - .549	1.23	.244

*Statistically significant at p <0.05

Table 5. Mean difference between chronological age (CA) and Willems age (WA) among different age groups

Age	N	CA		WA		Mean age difference	Confidence interval	t	p
		Mean	S.D.	Mean	S.D.				
5-5.9	19	5.45	.23	4.76	.35	.696	.572 - .820	11.77	.000*
6-6.9	18	6.54	.25	5.68	.53	.860	.633 – 1.086	8.02	.000*
7-7.9	22	7.44	.25	6.88	.53	.560	.390 - .730	6.86	.000*
8-8.9	25	8.58	.27	8.34	.60	.240	.036 - .445	2.43	.023*
9-9.9	19	9.45	.23	8.85	.39	.603	.352 - .853	5.05	.000*
10-10.9	18	10.53	.27	9.51	.60	1.02	.792 - 1.252	9.38	.000*
11-11.9	25	11.56	.29	10.59	.62	.969	.762 - 1.176	9.65	.000*
12-12.9	18	12.41	.26	11.61	.56	.804	.589 - 1.019	7.90	.000*
13-13.9	16	13.53	.29	12.66	.43	.867	.733 – 1.001	13.79	.000*
14-14.9	11	14.49	.27	13.47	.49	1.021	.744 – 1.298	8.21	.000*

*Statistically significant at p <0.05

DISCUSSION

Dental age estimation has been perceived to correlate with chronological age more than other maturity standards in the development of children.[20] The reason may be due to the fact that unlike other organs, teeth development are not affected even by nutritional status[21] and are guided mainly by genetic and environmental factors.[22]

Radiographs are commonly used for dental age estimation because it is convenient and noninvasive.[22] Among the radiographic methods of age estimation, Demirjian method has been used widely.

In the present study, there was delay in the dental age when calculating with both Demirjian and Willems method. Similar results were observed in a few studies done in selected Nepalese children population where Demirjian method was found to underestimate the age.[23, 24, 25] But the mean difference was very less in the present study compared to those other studies.[23, 24, 25] Thus, Demirjian's 7- teeth method was more applicable in the tested children.

A few of the other researches also have found Demirjian method underestimating the dental age.[12,13] However, most of the researches done worldwide has found Demirjian method to overestimate the dental age which go against the findings of the present study.[9-11, 26-31].

The scoring system in Demirjian method of age estimation has wide application in ascertaining maturity scores but when transforming these maturity scores into dental age it has revealed variations in populations. So, to determine the precise age, population specific standards needs to be developed.[14]

Referring to these concerns, Subedi et al has derived Nepalese population specific equation to estimate the dental age from Demirjian's 8-teeth method and that study has given acceptable results.[32] However, the method still needs to be tested in broader Nepalese population to draw the conclusion.

The variation in dental age seen by Demirjian method among different population may be attributed to ethnic differences[33] and a positive secular trend over five decades.[34]

Demirjian technique was modified by Willems and colleagues after 25 years of the original study. The technique has been simplified and yet holds the advantage of Demirjian method. There was reduction in the overestimation of dental age when applied in Belgian Caucasian population.[3] This method was then used in various population and was found to be more accurate than Demirjian method.[35-40]

In contrast to these studies, the present study revealed delayed dental age when estimated by Willems method and this underestimation was more than Demirjian method. Gupta et al also observed that Demirjian method was more reliable in North Indian female children as compared to Willems.[41]

In a study done in a small population of Nepalese children also found Willems method to underestimate the dental age.[42] But another study though underestimated the dental age by Willems method, had

performed better as compared to Demirjian with both the techniques exhibiting excellent correlation with chronological age in both the genders.[25] The present study also demonstrated strong positive association of chronological with dental age (DA and WA) for both the genders.

Another parameter of difference in dental development is the gender. Literatures have reported females being generally ahead of males in tooth formation and emergence.[43, 44]

Demirjian age of present study also revealed the dental age of female ahead of the male counterpart. But it was not evident in Willems age.

By both the methods; Demirjian and Willems, the dental age was underestimated in all age groups except for the age 5, 7 and 14 in Demirjian method which was statistically nonsignificant.

In a study done in Nepal by Nyachhon R overestimation was found in younger age of children; 7 and 9 years when Demirjian's 7-teeth technique for dental age was applied.[23]

Since Demirjian method involves the summation of scores according to the dental stages, a single change in the stage leads to a large bounce in the dental age and these types of difficulties have been encountered in higher ages as there is end of dental maturation.[35] This could be the reason for nonsignificant result of dental age by Demirjian method at age 14.

The variations in the result of the different researches depends upon different sample sizes, age group, statistical methods used and precision of the tested method.

Based on the result of the current study, Demirjian's 7-teeth method has been found to be more applicable than Willems method in selected Nepalese children population.

The limitation of the present study is that the sample represented only a specific Nepalese children populations. To make a strong judgement, it needs to be applied in a large scale considering the various ethnicities as well.

CONCLUSION

The Demirjian's 7- teeth method and Willems method underestimated the dental age in both the genders. The underestimation was more by Willems method. There was a strong positive relationship between chronological age and dental age in both the genders. Demirjian's 7-teeth method was more applicable as compared to Willems method when tested in selected Nepalese children population.

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